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ABSTRACT

This document contains the proceedings of a conference on technology and the future as it applies to occupational educators, with an emphasis on determining how vocational and technical education must change to meet the needs of the future. Following the introductory remarks on the themes of the conference, five presentations were given. In the first speech, Theodore Conant, consultant on technology information, engineering, and technical development, provides an overview of technology assessment, particularly in terms of its effect on the American work force. He comments that the U.S. is increasingly not competitive compared to Japan and European countries, which have a pool of human resources with a higher level of technical education. In the second presentation, Bert Cowlan, telecommunications consultant, outlines telecommunications technologies and their effect on future work and personnel. The third paper, by Larry Kamm, operating mechanical engineer and inventor of industrial robots, calls attention to the growing shortage of qualified maintenance engineers, and suggests that educators pay more attention to assessing the skills-learning potential of their students before directing them into high-technology fields. In the fourth presentation, Herbert Gerjuoy, futurologist, predicts the characteristics of the labor force in the year 2000 and the general technological trends and educational preconditions for changing work attitudes. Finally, Dr. Michael Hudson, consultant and technological forecaster, provides a macro-overview of how technology assessment information can be used in occupational education and what education can do to solve problems of long-term unemployment. (KC)

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TECHNOLOGY ASSESSMENT AND OCCUPATIONAL EDUCATION IN THE FUTURE

Proceedings of a Conference

Multi-Sponsored by

Office of Occupational Planning
Bureau of Occupational and Adult Education
U. S. Office of Education

The Council for Occupational Education
The American Association of Community and Junior Colleges

The President's Academy

The American Society for Training and Development

Chicago, Illinois
April 29, 1979

Edited by Stephen Sniegowski, Ph. D.

U. S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CF 029555

This Conference took place under the auspices of the U.S. Office of Education but the proceedings came off the press after the Office's staff, programs, and functions were transferred to the U.S. Department of Education upon its establishment May 4, 1980. This document nonetheless contains valid information as a publication for the Department of Education, despite any seemingly current references in it to the Office of Education, its Bureaus, other organizational subdivisions, or activities.

The views presented by the Conference participants do not necessarily reflect the views of the U.S. Office of Education, the Council for Occupational Education, the American Association for Community and Junior Colleges, the American Society for Training and Development or the new Education Department.

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PART I - EXECUTIVE SUMMARY

The Conference was for not only those who attended but also for the many persons concerned with technology assessment and occupational education in the future who were not able to be present. Therefore, a Conference Proceedings is in preparation. It is hoped that the Conference and the Proceedings will encourage the convening of similar conferences addressing local and regional concerns, and further disseminating awareness of the board issues discussed at this national Conference.

The Conference Moderator was Dr. Ann Martin, Associate Commissioner, Office of Occupational Planning, Bureau of Occupational and Adult Education, U. S. Office of Education. Dr. Martin organized the Conference in part to encourage a systematic effort to develop an effective methodology for dealing with what has been held by some to be a longstanding weakness of occupational education: education for obsolescent occupations utilizing outdated occupational skills. Occupational educators must be aware of the likely future pattern of job hiring and skill utilization. To do this, occupational educators must have access to appropriate projections of personpower needs. Also relevant will be projections of the development of education and training technology, because these latter developments will help determine the educational and training needs that will have to be met in the future by occupational education.

Unfortunately, while the pace of change is accelerating, both in personpower needs and in educational/training technology, there has been no corresponding progress in the development of suitable information resources for occupational educators. This deficiency calls for development of a futures-oriented data

base that will provide convenient, readily comprehensible, suitably comprehensive information about the past, present, and anticipated future relevant to planning and development in occupational education.

Theodore Conant, former Director of Schroeder Technology and a consultant on technology information for the J. Henry Schroeder Banking Corporation, cited recent studies showing how the United States increasingly is not competing effectively for international markets, particularly when faced with Japanese and European competitors whose personpower is drawn from a pool where technical education (including basic mathematics and science) is generally at a higher level than is common in the United States. The drive for increasing automation in the United States in part reflects growing despair about the quality of human workers on the production line. In addition, the heavy investment by the United States in high technology dedicated to military applications has had a chilling effect on the growth and health of non-military high technology.

Mr. Bert Cowlan, an Associate of the Institute for Public Administration and former consultant to the State of Texas on development of a statewide satellite communications system for social and educational systems and services delivery, and former consultant to the U.S. Department of State on satellites and telecommunications policy, pointed to the growing need for managerial skills. He indicated that the future rising costs of transportation will favor inter-linking homes and offices with improved microwave and telephone circuits that permit more and more managerial work to be done from an office in the home, with more and more persons using large-scale information processing equipment routinely in their work. Videoconferencing will become increasingly common. However, as we become increasingly dependent on a broad-channel

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communications (video, computer, etc.), we will become more and more vulnerable to technological breakdowns. We will need a large pool of persons qualified to work with, repair, refit, redesign, upgrade, etc., the electronic communications and information processing equipment that will be as important in tomorrow's American society as the automobile is today.

Dr. Herbert Gerjuoy, Senior Staff Scientist with The Futures Group, Inc., of Glastonbury, Connecticut, traced broad demographic, economic, job education, and social trends that will help determine future environment for occupational education. The average age of Americans will continue to rise. There has been in the past quarter century an unprecedented increase in the life expectancy of older Americans, and this increase will become even greater in the years to come. This, plus a new baby boom, will contribute to a sharp rise in total population of the United States.

Americans will not only live longer but also they will stay healthy and vigorous longer. The public and private retirement systems will generally run out of reserve funds and will need large contributions from other than future beneficiaries if they are not to default on their obligations to beneficiaries. Such contributions will help maintain the long-term inflationary trend, unless there is an unlikely sharp increase in general taxation. The weakness of the retirement systems plus the increased health and vigor of older Americans will favor a trend toward later and later retirement.

The depletion of the capital of the retirement system will contribute to a general deficiency of investment capital, just when large investments will

be needed to upgrade American industrial and business technology, and to help develop the necessary complementary new educational technologies that will be used to prepare workers for the new work environment.

Later retirement will mean fewer new jobs available for youth, minority-group members, and women. In part, new jobs will be made available by taking more and more people out of the work force in mid-career for retraining and updating. The increasing pace of technological change will also favor continuing and ongoing occupational education for adults. Educational credentials will tend to depreciate with time unless "renewed" by continuing training. Rapid technological change will also favor more general, rather than specific occupational education.

The revolution of rising expectation in American society will continue to be a source of profound social unrest. No matter how hard we try, 50 percent of the American population will be below the median in income. But fewer and fewer Americans are content to be below the upper 10th percentile. Americans are less and less satisfied with an absolute improvement in their living standards, unless there is also a relative improvement—relative to the norm for American lifestyle.

The necessary disappointment that rising expectations will bring about will be reflected by increasing questioning of traditional values. In particular, liberal and optimistic views of the social and political scene will decline in popularity; conservative, simple, unambiguous, pessimistic outlooks will be favored.

American mass culture will tend to fractionate into diverse subgroups with different, distinct values and affiliations. One broad value trend will be toward the belief that work and the work place should be enjoyable as well as profitable.

Mr. Larry Kamm, an experienced operating mechanical engineer specializing in industrial automation, was not able to be present at the Conference, but he sent a paper that was read for him.

Mr. Kamm called attention to the growing shortage of qualified maintenance engineers. Factory managers tend to hesitate about hiring technicians because they have difficulty evaluating them, either before or after they are hired, and they are even more reticent about adopting new technologies because they do not see how they will be able to maintain the equipment.

The major problem in getting workers to avoid goofs is not one of cognitive or skill learning; rather, it is a problem in motivation.

Skills necessary for working with high-technology equipment are relatively easy for some people to acquire, relatively difficult for others. Better ability/talent evaluation and better vocational counseling of those either qualified or unqualified for such work could reduce substantially the strain on educational system.

Dr. Michael Hudson, an economist and futurist now a private consultant, spoke on how technology assessment could provide information to be used in occupational education. He pointed out that governmental planning has tended to underestimate the vast impacts of technological change. He suggested that since neither

government nor industry are likely to bestir themselves to anticipate the impacts of technological change, it may well be left to occupational educators to perform the necessary analyses and so help ensure that the products of vocational education find suitable jobs waiting for them.

The meeting was convened by Mr. Andrew Korim, Provost, Community College Component, West Virginia State College and past President of the Council for Occupational Education, an affiliate of the American Association of Community and Junior Colleges. The panel of reactors included representatives from government, business, and education. Formalized reactions to the ideas and issues presented in the program were provided by:

- Ms. Kathleen Arns -- Assistant Vice President for Vocational Curricula
Oakton Community College
Morton Grove, Illinois
and
President, Council for Occupational Education
American Association of Community & Junior Colleges
- Ms. June Dains -- Personnel Director
Nystrom Division--Carnation Company
Chicago, Illinois
and
Member, American Society for Training and Development
- Mr. George Koopman -- Chairman
Instructional Systems Group (Insgroup)
Pacific Palisades, California
- Mr. Ray Nelson -- Manager, Technical Training
The Milwaukee Road
Chicago, Illinois
and
Member, American Society for Training and Development

- Dr. George Pratt — Special Assistant for Education
Department of Commerce
Washington, D.C.
- Mr. Clinton Smith — Director, Office of Equal Employment Opportunity—Internal
Office of Personnel Management
Washington, D.C.

and

Member of the Board
National Association of Industry Education Cooperation
Buffalo, New York

PART II - INTRODUCTORY REMARKS

MR. ANDREW KORIM: This session on technology assessment in occupational education in the future is co-sponsored by the Council for Occupational Education and the President's Academy, both affiliates of the American Association of Community and Junior Colleges, and the American Society for Training and Development.

The Council for Occupational Education is extremely pleased to join the co-sponsors. The theme, Technology Assessment and Occupational Education in the Future, cuts across the priorities of the Council about as completely as any theme that we could have.

As occupational educators, we hope to become more responsive to technological developments. If we can develop some awareness and appreciation for some of the developments that are ahead in the future, we can begin to think today about how we should respond in our various curricula.

Our second objective is to look at the technological opportunities that can help us improve our delivery capacities and increase our productivity.

Obviously, all we can do here today is set in motion events that we hope will continue for at least the next 18 months. We have talked with the Office of Education about the Council for Occupational Education joining with that agency on an 18-month technology assessment program. We hope to develop a set of proceedings from today's session which can be sent to people not here today.

We hope that this session today will inspire you to take action at the local level.

Our moderator today is Dr. Ann Martin, Associate Commissioner, Office of Occupational Planning, Bureau of Occupational and Adult Education, U. S. Office of Education. She is the initiating force behind this program. She has had a number of years of experience in the educational world, and this program reflects her expertise.

DR. ANN MARTIN: Thank you. I am delighted to be here this afternoon and to serve as moderator for this program. I feel akin to many of you in the audience, because one of the best jobs I ever had prior to coming to the U. S. Office of Education was in community college administration. I am committed to community colleges, realizing that they fill a great need.

We are pleased by the response to our invitation to Council and Academy members. We do regret that we do not have more individuals from business, industry, and labor. However, our panel consists of presentors and reactors from outside of education.

I want to correct one statement made in the announcement sent to Academy and Council members, which held that we were going to commission papers for this event. Due to a cutback in funds at the U. S. Office of Education, we were not able to commission papers, but we were able to bring the presentors here. We are going to tape the proceedings from which we will develop a document for distribution.

Since this program is an experiment, we would like to have your reactions. This will enable us to determine whether we should continue this 18-month effort, which will include regional meetings and other longer-term activities.

Now I want to say a few words about my office, the Office of Occupational Planning. My office is in the U.S. Office of Education; it is the policy planning and evaluation arm of our Bureau of Occupational and Adult Education. Its functions include engaging in policy studies and planning for the improvement of occupational education and developing and maintaining a data and information system capability for resource analyses of needs. This includes forecasting of work force needs and education and training requirements. Our office is also responsible for organizational and agency coordination, particularly as it relates to local, state and federal planning, including planning in the area of industry, education, and labor cooperation. Finally, our office makes policy recommendations to the Office of Education on priority legislative issues, such as youth employment, occupational education, and economic development.

Now, we have all heard, I am sure, the criticism that vocational education has been and is currently training persons in fields which are not demanded by today's labor market. I am sure you have heard the comment that we are producing buggy whip craftsmen in an automobile age. We are faced with the fact that market demand for labor is constantly in flux, due to changes in technology—technological innovation and obsolescence—which cause shifts in patterns for the hiring and utilization of personnel. Vocational education, focused on certain traditional occupational fields, has not kept pace with shifts in technology. In addition, the public school system is currently criticized for producing students unable

to read, write, or compute and even those able to perform these simple tasks are technologically illiterate. They have no basic understanding or knowledge and skill background in the technology of today. This is especially the case for women and minorities.

Regarding the concerns of this conference, no system or concerted strategy has been developed to assess current and future shifts in technology, their effect on the labor force and, most importantly, the ways in which vocational education and occupational education might revamp their programs so as to stay attuned to the needs of today's economy.

The Office of Technology Assessment under the U.S. Congress has failed to emphasize manpower development and education and training needs in its various projects and reports and probably will continue in its neglect. Meanwhile, the Bureau of Labor Statistics does not assess to any marked degree the impact on jobs and manpower needs stemming from shifts in national and international policies and corporate programs.

In an age of rapid technological change it is essential to develop methods of projecting work force needs and work force data on a one, three, five year planning basis. This would benefit business and industry by giving them a better pool of trained job applicants. It would benefit the school system by enabling it to attune its curriculum to the needs of the marketplace; and it would benefit individuals by providing them a chance to prepare for the job opportunities available.

What we need to focus on in this conference is an overall consensus as to where we are. First, what is the state of technology in the United States? Are we losing

our technological edge, as Frank Press, the Science Adviser to the President, recently warned us?

Second, while jobs are moving offshore at a rapid rate, we are faced at home with the problem of structural and youth unemployment. Furthermore, this is inextricably bound with the recently emerging concern for the unemployment or underemployment of overeducated adults. From recent reports on federal programs designed to address the former problem, it would appear that we are being criticized in many places for just throwing dollars at problems.

Third, more attention needs to be paid to carrying out the provisions of recent pieces of legislation such as vocational education amendments with their emphasis on annual and five year planning.

At a meeting I attended just two days ago in Cincinnati sponsored by the National Association of Industry-Education Cooperation, the Assistant Secretary of Education's Office addressed the need for more public involvement in plans to modify national educational programs. The problem is, however, that we cannot obtain, as Congress has long been aware, the kinds of data required for matching manpower supply and demand with education and training needs. The reasons, I am sure, seem obvious. Technological diversity raises innumerable obstacles against accomplishing these ends.

Another problem is the difficulty of acquiring data from business and industry that project their future work needs. There is also the added factor today of attempting to do planning of a local, regional or national scope in a transnational, interdependent world. Furthermore, we lack a central clearinghouse of what

works and what does not work. Thus, all combined, we are always acting from a limited base of static information in a moving, changing world economy.

My final point is that, before we can ask the right questions at the conference today, we have to determine the universe we are dealing with. We must face the fact initially that we may well be forced to look at occupational planning and data to support planning on a worldwide as well as a national basis.

Now, with that thought I would like to turn and introduce the presenters for today. I am going to introduce them and then turn the program over to them. I am going to ask the audience to hold questions. We are going to limit the presenters to ten or 12 minutes. Then the reactor panel will spend three to five minutes commenting on the presentations. Finally, the meeting will be open to audience participation.

Our first speaker today is Theodore Conant, the former director of Schroeder Technology and a consultant on technology information for the J. Henry Schroeder Banking Corporation. Mr. Conant is coordinator of engineering and technical development for digital optical television systems and provides a liaison and direction to the research program in three dimensional television. A recognized leader in the electronics communication field, he has served as a senior executive at CBS laboratories. Now, I believe that Mr. Conant will provide us with an overview of technology assessment, particularly in terms of its effect on the American work force.

Our second speaker will be Bert Cowlan, an Associate of the Institute for Public Administration. Mr. Cowlan's field of expertise is telecommunications.

He has worked as a consultant to the State of Texas for a statewide satellite communication system—telecommunications system for social and educational systems and services delivery. He has also worked with the U.S. Department of State, Bureau of Educational and Cultural Affairs, as senior consultant for satellites and telecommunications policy. Today, Mr. Cowlan will address us on telecommunications technologies and their future impact upon work and personnel.

At this time I would like to make a note of correction in the program. It is one of personality and not substance. Due to a last minute crisis, Larry Kamm is not able to be with us today; however, he sent us his remarks which will be read by Dr. L. Mayrhofer. Mr. Kamm offers the perspective of an inventor who has designed and produced automated and robot machines. Possessing a thorough working knowledge of the potential of this machinery, Mr. Kamm's presentation will outline its expected effects on the American work force.

Herbert Gerjuoy, of the Futures Group of West Hartford, Connecticut, will be our fourth speaker. Dr. Gerjuoy has developed a number of studies concerning the future characteristics of the labor force and for the National Science Foundation he conducted studies on the consequences of changes in life expectancy. Dr. Gerjuoy will be addressing us today on the characteristics of the labor force in the year 2000 and the general technological trends and educational preconditions for changing work attitudes.

Our last speaker will be Dr. Michael Hudson. Dr. Hudson is engaged in private consulting and technological forecasting for a number of organizations, including the Canadian Secretary of State, the Canadian Science Council, Unitar, the Institute for Research on Public Policy and the Futures Group.

Mr. Hudson will provide a macro-overview of how technology assessment information can be used in occupational education, and, I think, will say a few words about how much education can do to solve some problems of long-term unemployment.

I am now going to turn the program over to our first speaker, Mr. Theodore Conant.

PART III - PRESENTATIONS

MR. THEODORE CONANT: Thank you very much, Ann. It is a great pleasure to be with you here in Chicago. Ann did not get far enough in my vitae to remind you that I am also an academic, perhaps I should say former academic. For a while I taught courses related to mass media, educational broadcasting and publishing at the Harvard Graduate School of Education, and before that, I was an adjunct professor of communications at Syracuse University. I am currently filling my educational dues or trying to pay a few of my dues by teaching at New York University, when I can find the time, in the area of film, television and broadcasting.

My remarks are going to be rather controversial. So first let me say a bit about my sources to demonstrate that I am not absolutely alone in some of the views I am going to present. In the area of looking at the impact of technology on employment, we have been rather remiss in this country, and I think this is partly because many of our think tanks are very closely tied to government and thus under political constraints.

Ann has said a few polite things about the Department of Labor. I am afraid I would have to underline it in the sense that I believe that most of their reports contain more fantasy than fact, and that many of the unpalatable realities of our present economic situation are minimized by them for political reasons. There are exceptions, however, and having slapped them on the wrist, I would like to point out one or two of the exceptions.

One of the people I am most indebted to for some of the background information which I will try to briefly summarize is Jack Baranson, formerly of the World

Bank and now directing a little think tank in Washington. If you find my presentation interesting, I would strongly recommend his new book, Technology and the Multi-Nationals, published by Heath, Lexington, and also his recent report for the Department of Labor, entitled, "Sources of Competitiveness in Japanese Color Television and Videotape Recorder Industry," issued by his little think tank, Developing World Industry and Technology. This latter report says some very important things about where the United States stands competitively in the electronics sector of our industry, although he does underplay the effects of the military.

My presentation about where the United States economy now stands also derives in large part from my own experience as a consultant to business and as a consultant to some of our multinationals. A good deal of statistical backup comes from European, British and Canadian sources. I am particularly indebted to the Institute for Research on Public Policy and the Science Policy Research of Sussex University. Both organizations have put out occasional papers on the impact of micro-electronics and other industries on the structure of national economies of Europe, Japan and the United States. I have a batch of these reports if any of you are interested in looking at them. In preparing these reports, experts were sent to examine the respective economies at great length in an effort to penetrate the myth and fantasy of official statistics to get at the nitty-gritty realities. I am greatly indebted to these proprietary reports for some of the rather disturbing information I am going to present now.

In a way it is very appropriate to talk about technology in this setting, because this ornate ballroom was built in the grand old days of Chicago, when people were writing and talking about Chicago, as the hog butcher and the iron monger of

the world. This was an era when America's gross national product was expanding, when our technology was accelerating, when the American flag was being planted on a palm and pine and the sun never set on it.

Now, the American flag is retreating. Our productivity is retreating. Our technology is declining. So in a way to talk about technology past and present in this ornate, nouveau rich setting is perhaps most appropriate.

A recent Canadian think tank report on the growth prospects for the United States and Canadian manufacturing industry paints a picture of almost unrelieved gloom and uncertainty. The following notation perhaps illustrates the tone of the report. "It is apparent that in many key areas technological capability of North American industry has not improved. It has in fact deteriorated."

Now, it is significant that this report also emphasizes a lack of technological capability as one of the root causes of the malaise of the manufacturing sector. This lack of technological capability takes two forms: a new wave of automation of the manufacturing process and a fundamental change in the nature of the products manufactured, such as the replacement of mechanical products by electronics.

As part of a European OECD research program, Dr. Mick McLean formerly of the Science Policy Research Unit and currently editor of a leading trade weekly, The Electronic Times, interviewed the leading multinational electronics firms in the United States, Japan and Europe. One of McLean's most important findings was that even in this country major multinationals, and particularly the smaller firms, do not expect to increase their employment. This is particularly important

for America because in this country, unlike West Germany, automation is proceeding relatively slowly, because of the high cost of capital. But even in the U.S. firms do not expect to increase their employment over the next few years, despite an anticipated enormous increase in output, especially in the electronics sector. McLean's conclusion concides with the Canadian report mentioned earlier which also notes a slowdown in growth rates in all industrial countries, particularly for a number of the fastest growing industries of the 1950's and 1960's. On the basis of detailed review of recent economic developments, this report concludes: "Although labor productivity may continue to grow at a high rate, manufacturing will no longer be a source of increased employment. It may even, like agriculture, be a sector of steadily diminishing opportunities for employment." And the report continues, "If the growing pessimism of economic analysts about the condition and future prospects of the industrial economies is well founded, competition for markets and resources will be fierce and unrelenting and, as in all struggles, the weak will be the first to fall."

The industrialized age is ending. Although many people still find it difficult to imagine anything other than a business as usual future, such a future is probably not feasible for the existing major industrialized countries.

Americans assume prowess in every area of international endeavor, including superiority in trade and in scientific and technical efforts. Recently, it seems, we can no longer take our superiority for granted. Other nations are seriously competing with and dominating markets once thought to be the exclusive domain of American industry.

The reasons that the United States is losing its edge in many markets are complex. We all know the United States is becoming less competitive. Today there are virtually no 35 millimeter still cameras and practically no motion picture cameras made in this country. A decade ago 80 percent of the movie cameras that filmed the feature films of the world were made in this country—made out on the West Coast, near Hollywood.

Color television sets, once produced almost solely in the United States, are virtually no longer manufactured in this country. The United States maintains really only a lead in three high technology areas: computers and related micro-electronics processing, particularly high density chip making; the aerospace industry; and heavy electronics—large industrial jobs like broadcast videotape recorders, instrumentation recorders and similar products and the kind of extremely complicated instrumentation that firms like Hewlett-Packard excel in.

But the Japanese are investing huge sums and are closing the gap in instrumentation and in the computer industry. The Japanese intend to do to IBM what they did to the British shipbuilding industry. And I give them a very good run for their money. Those of you who hold IBM stock should reappraise it yearly. It is doing rather well now, but I would not give it much of a shake ten years from now. It may well go the way of railroad stocks, for some of the same reasons.

Each year we are spending a smaller percentage of our gross national product on basic research and development. Meanwhile our main competitors have increased their efforts in this area. There are many reasons for this decline: lack of venture capital, restrictive tax policies and the tendency of large corporations to excel

in production and marketing while leaving the tasks of making technological breakthroughs to smaller industries.

Military spending also has had a deleterious effect. Military R & D, contrary to myth, is not beneficial to the private sector. Initially in the late 1940's and early 1950's it was marginally helpful in the areas of aerospace and electronics. But increasingly the military is developing complicated machines, enormously high density chips in the electronic sector, for example, in order to build billion-dollar smart machines capable of destroying the other side 100 times over.

And this kind of very high technology, Ph.D.--intensive R & D, is not helpful to the private sector. Indeed, those of you who read Electronic Trade Journal will notice that most of the major ship manufacturers have turned down the recent Department of Defense requests for R & D programs in heavy chips--Intel, for example.

The technology policy makers of the United States both at the government and industrial level are now in their 50's and 60's. Their last working level contact with engineering innovations was 20 years ago, when we had unchallenged leaders. Many still believe that no one can do anything better than Uncle Sam. Caught in their own myths, they are not inclined to adopt from and copy foreign innovations. Many of these individuals now are beginning to study the Japanese experience, but emotionally they do not believe the wellsprings of the Japanese success.

In addition, America's technological troubles stem from the fact that we are a nation continually in a hurry and continually on a very short-term planning

cycle. You all know the facts about our government, but unfortunately, business also operates on a very short-term planning cycle. I could go on at some length about this, but I won't because you are quite aware of the fact that basically our bureaucracies, both in education and the private sector, are amiss in long-term planning.

But the bottom line of all this—an a particularly disturbing portent for the U.S. economy—is the dimensions and the nature and extent of our failure to develop new technology and the outward movement of technology that may be taxing the limits of our economic adjustment capacities. The release of the most advanced, sophisticated and, hence, competitive technologies to commercially astute and aggressive foreign enterprises has the potential of raising havoc in the job market.

The Onda Fujitsu and the Komings Komitsu agreement is a case in point. In the former instance a Japanese partner is already in the process of licensing acquired computer technology to Western European partners and is therefore out-flanking U.S. access to that market with other products of technology.

This is particularly crucial in the area of micro-processors—computer networks, so tiny they are virtually invisible to the naked eye. The micro-processor revolution has come upon us quickly. In 1950 only 1,000 computers existed in the United States, and micro-processors had not yet been introduced. By 1976 the number of computers had risen to over 200,000, and now three-quarters of a million micro-processors have been produced and ten million are projected for the 1980's. With advancing technology the micro-processors are becoming smaller and less expensive

to produce. As micro-processors become smaller it has become necessary to have them designed by computers.

Advocates of the new industry claim that the technological advance will create new, more enjoyable jobs than are presently available; however, the union members and politicians in Western Europe are already battling over the threat of outright destruction of entire occupations by micro-processor automation.

Critics of the new technology point out that the introduction of the micro-processor in West Germany has led so far to widespread layoffs in the teleprinting, sewing machine and cash register industries. There are indications that in the word processing area the layoffs will also be extremely serious in Western Europe.

A recent article by Mick McLean on the effects of micro-electronics in Europe and the United Kingdom argues: "There are some industrial activities in the EEC countries and the United Kingdom within which the micro-electronic technology is likely to fuse very rapidly, and in word processing, automated materials handling, and in these cases the direct effect on employment is likely to be severe and not compensated much by manufacturing employment."

And another respected academic, Professor Tom Stoner of Bradford University, recently reported that he feels that within 30 years Britain will need no more than ten percent of its work force to supply all its material needs. While this statement is obviously not intended as an accurate employment forecast, it does indicate the extent to which Professor Stoner believes society will be affected

by the micro-electronics revolution. Now, it is not for me to discuss the impacts of this on education. The speakers that follow should deal with this issue.

In closing I would like to point out that many of the top academics in England, Europe, and in Canada, who have studied this technology problem more seriously and more carefully than we have in this country, see the warning signals clearly. For example, Sir John Maddock, fellow of the Royal Society and secretary of the British Association for the Achievement of Science, has just written a very lengthy and perceptive paper dealing with the reappraisal of the role of work as the industrialized world moves into a new era, the micro-electronics era, called the post-industrial era.

I would like to end my paper by urging that you look at his work and that of other European experts as they urge educators not to train people to make buggy whips, not to train people in punch card computer programming—something that will become obsolete as a buggy whip—but rather to train people to write clearly, to think clearly, to do their math clearly, to develop the kind of skills that will enable them to change from job to job. Educators must provide people with the wit and the cunning and the basic tools to survive in a society where relatively few people will be employed, and far more people will be drawing subsistence checks from government authorities.

MR. BERT COWLAN: Let me start with a bias. It seems to me we're at a point in history where what Einstein once said about another revolution, the atomic one, rings true. We are on the threshold of an electronic revolution. As

Einstein said about the atomic one, "Everything has changed except the mind of man." Another of my beliefs which you may judge to be a bias, is that the length of time between an invention of an innovation to its acceptance is seven to ten years, except in education where it is 40 years.

My original brief was to deal with the "bag" of technologies which will either of themselves or as a gestalt alter the way we work in the mid-range future and beyond. What are some of these devices? Why will they change not only how we work in the future but what we must be teaching workers now?

Anything I say must be thought of in the context that as of this moment professionals and managers now hold one out of four of the nation's jobs. The implications of those statistics are staggering to me. They should not be staggering to anyone who has knowledge of the underbelly of our society or the huge number of unemployed.

If even now the required skills are managerial, what will it be like as a result of the proliferating transistor revolution, when to run a simple typewriter greater intelligence and skills will be needed? What will happen when offices disperse because of the rising costs of transportation and we can tie those offices together with improved microwave, telephone circuits and telecommunication satellites, and when the video disk may offer every home/office the equivalent of a fairly large computer in today's terms?

What happens when these things break down? What happens too when terminals proliferate and the high speed and agile use of words become a job market necessity?

Are we preparing ourselves, or anyone, for this state of affairs, for this clearly predictable event?

Now, let us take a quick look at the technologies. Ideally, from both an educational and a performance perspective they should be transparent to the user. The telephone is virtually so, but we have had it for about 100 years. The television set is, but in its passive mode. Many are frightened of it as a two-way device, finding its use inhibiting. Yet the video conference is the equivalent of a two-way video, and video conferencing in a variety of managerial situations is on the increase and, as broad band communications satellites proliferate, will increase even faster.

And as offices disperse, as the home/office becomes more common, and OPEC may insure that for us, the use of videoconferencing will probably increase on a lower than managerial level. Is anyone teaching office workers of the near-to mid-range future how to use the techniques successfully? And parenthetically, is anyone teaching people how to repair those machines?

I mentioned satellites. In a relatively short period of time, if IBM, Comsat and Aetna Life Insurance have their way, a system of satellites—business systems satellites—will be in place. They will enable high speed data to flow from corporate headquarters to branches, from branch to branch and back again.

I do not think it takes too much transistor gazing to leap to the assumption that, while it is impossible to determine precisely what will change, something will, and soon. Are we as educators gearing up to cope with the need for that

change? I wish I knew the answers. I only suspect—well, I am a bit stronger—I am sure the answer is probably in the negative.

And I have left out a lot of technologies: word processors, high speed facts machines, smart typewriters, smart telephones, ubiquitous calculators. In many ways electronics will make life and work easier for some. What I wish to point out here for your consideration are a few issues which fall beyond the technological.

I said we are in the midst of a revolution. Call it electronic. Call it informational. When steam engines mechanized what had been the family farm at the time of the industrial revolution and turned agriculture into agribusiness, those driven out could leave England or Europe and come to America or Australia in order to regain the practice of small farming.

The interesting question to me is what will happen to those driven from semiskilled labor—and I'd forgotten to mention the rapid development of robots for a wide variety of assembly line jobs—driven from clerical labor, secretarial labor, ditch digging labor, perhaps even teaching labor, as video brings master teachers live via satellite into each home? What will be the result of those individuals' inability to handle the steam engines of our era: the electronic processors, the computers, the two-way video, the machines that think?

A closing thought, perhaps a chilling one that has only recently occurred to me. As the technology allows for dispersal of semiskilled work force and as the technology permits the home to become a total work-entertainment environment,

will this not have the net effect of placing control in fewer and fewer hands? If middle management must communicate through control centers, monitored by top management, how are two or more middle management people ever to get together to create a new idea, spin off a new company or, on another level, form a union or just have a drink?

In Orwellian terms, and the state of the art is near, the television set you watch for pleasure or soon for business is also capable of watching you. I am no Luddite. I would not hold back the steam engine of our era. What I would do and am doing is to enter a plea to the educational community to take some time to think about the social implications, let alone the vocational and educational ones, of what is now taking place.

The technologists have gone to the great pains to place in our heads visions of transistorized sugar plums, otherwise known as telecommunications satellites, shining in the skies. The educational community, at least in my experience, has not challenged the basic fact that the very shape of the technology—the kinds of technologies chosen for different uses—has a shaping effect on the users.

Technology is in the saddle. The users have yet to use the rings or spurs as they see fit. Shaping the technologies to suit educational and social needs is very much an educator's job. And to me technology assessment is part of the process which leads to that kind of sculpturing for human need.

In my view, we have too long ignored the assessment of what technology can do to us. We may have less time than we think. Thank you.

DR. GERJUOY: I have five parts or main headings: demographic trends, job education trends, social trends and finally something about the work ethic.

The headlines for demographic trends are: birthrate down and population up; the population getting older; and a new baby boom coming. The birth rate is now, in the long run, below replacement. But it will take a while before the population in the United States stops growing.

What is happening, though, is that the population is gradually getting older on the average, and as it does, the death rate is going up. Eventually the death rate will go up enough, so that the number of people who die each year will equal the number of people who are born each year, and in fact before things level off we will reach a stage, if the birth rate does not go up again, where the population would actually shrink for a while.

All this assumes that present death rates continue for each age group, but they are not going to. Since about 1950 something remarkable has happened in the United States. Older Americans have started to live longer, and this is new in the history of the world. Until about 1950 a person in the United States aged 50 had roughly the same life expectancy that a person in the city of Rome had 2,000 years ago.

The entire shift in life expectancy until a generation ago was due to a reduction in death rate for babies, young children, teenagers and young adults. Now we have started to see older Americans living longer for the first time, and this is a very, very sharp trend. In fact, in recent years it is so sharp, that in 1976 the

life expectancy for an American aged 40 increased one year in that very year. That is about as much as you can expect.

The baby boom is coming again, not because birth rate will increase strikingly, but because there will be more people of child-bearing age. This part of a distinct cycle of child-bearing, booms and bursts. This cycle is about a 30-year cycle, and so every 30 years in the United States, we get a shift in the rate of baby production which is about 1.8 to 1. In other words, we need almost twice as many schools, and then 50 years down the road a piece we need almost twice as many nursing homes. The next boom will come along just about in the 1990's.

All right, next trend—economic trends. Headlines proclaim that retirement systems are going to crash. That means the destruction of all the public, the private, the personal, and the insurance systems.

And the second headline might be called capital crunch. The term systems are going to crash because, while they have been in theory actuarially sound, they have been sound only on the basis of assumptions which were false.

First of all, it was assumed that life expectancy for older Americans would not go up, but it has. Secondly, it was assumed that new Americans would keep on coming along to contribute as young people to the retirement funds, as in the Social Security system. But when the birth rate declined sharply, the introduction of new American workers to contribute to the funds was not sufficient to keep up with the increased number of old Americans.

We all know that the Social Security system now requires infusions from the General Fund, but the same thing is true for TIAA and for just about every private system or public system in the land, except those which are heavily supported by other sources and contributions by the members themselves. These declining pension funds have been one of the major sources of investment capital in the country. This kept the capital system going. For the remainder of this century, it will be very difficult for the United States to raise sufficient funds to provide the capital plant necessary to provide the jobs to keep the economic system from running down. Job trends and educational trends are linked together. One of the important implications of the change in life expectancy is that there is an even sharper change in health expectancy. Older Americans are not only living longer, but they are staying healthier and vigorous much longer. The principal cause for the reduction in death rate of older Americans is a sharp and really not understood at all decline of the incidence of heart disease and vascular disease. Older Americans are not having heart attacks. They are not having strokes, not having as much hardening of the arteries, and they are staying vital and vigorous and energetic longer.

When older Americans die, they die faster. In fact, they are more like the miraculous one-horse shay. Different parts of the body are going to pieces at the same time. One of the consequences of this is that, particularly for Americans who have better jobs, there is increasing resistance to early retirement. There is a sharp reversal of a long-term trend in this country toward earlier and earlier retirement.

Moreover, these elderly Americans do not want to work full time. What they want is some kind of part-time employment, where they control the days or times when they work and where if they do not feel like coming in to work on a particular day, they can stay home.

Increasingly, the system is going to have to accommodate this drive toward later retirement. A major reason for this is that this is a way to save the retirement systems by keeping the workers working longer, contributing longer and drawing retirement pensions later. Another reason for this is that the nature of work in the United States places less emphasis on the physical vigor and strength of youth and now favors more and more the kinds of skills possessed by older Americans.

If you look at changing demography, which does not supply as many young Americans for a while in the work force, the pattern is clear. Now, this slower exit from the work force, however, puts greater pressures than ever on the declining job market, meaning that younger people are denied those positions.

When an American stays in the work force instead of retiring, however, he does not use up one job, because by staying in the work force that American consumes more as well, creating other jobs. The exact number of jobs created is unknown. Economists, by making very plausible assumptions based upon insufficient data, can make good cases for a job creating effect of from two-tenths to eight-tenths of a job for every job retained. I do not think the answer is sufficiently unpolticized for a fair and reasonable answer at this time. All we can say is that a full job is not used up when an older American stays in the work force.

In any case, I think the trend will be to deal with this by gradual exits from the work force, slowed entry to work force, and a variety of stratagems which will encourage people in the middle of their work careers to work less, to take more time off for retraining and sabbaticals, and to work part-time. These are all devices for using up the extra space created by people staying in the work force longer as well as dealing with the problems created by automation, which will also require increased retraining.

Now, this is the context of increasingly rapid technological change, and the concomitant increasingly rapid change in job demands. One of the ways we, as educators, can deal with this changing technological work is by moving toward more general education away from specific education. But there is a point of diminishing returns about this, because employers want employees to have certain definite, specific skills.

As the job market is changing more rapidly, necessary skills change more rapidly, causing a greater demand for ongoing, continuous education. For example, I received a doctorate in experimental psychology from the State University in Iowa in 1953. And the State in its infinite wisdom concluded that I had a doctorate for life. If instead I have been awarded a certificate as a cosmetologist, I would have had to come back every couple of years to be recertified. Apparently the State believed that a cosmetologist was a more critical enterprise than a psychologist. The State was probably right, but I think we are going to see an increasing trend toward a semi-revocable degree.

Official accreditations and degrees will not be revoked, but increasingly there will be expectation built into career ladders for ongoing training and demonstration

of ongoing competence. Unless one wants to accept a slow decline in the value of one's degree, and the knowledge explosion inflates knowledge requirements, it will be necessary to take part in ongoing education, particularly ongoing vocational education.

Regarding social trends, we face a number of revolutions of rising expectations, all of which are very uncomfortable for the American scene, because they collide with certain fundamental, logical, mathematical necessities. No matter what we do, 50 percent of the American population will be below the median income. No matter what we do, 50 percent of the American population will have an IQ under 100, because IQ tests are designed so the median IQ is 100.

Increasingly, however, American feel the definition not of success but of non-failure in the American scene is to be above the median in everything: intelligence, health, affection for one's children, etc. This is clearly a hopeless dream, and so we are becoming a nation of losers. A nation of losers is an uncomfortable nation, and so I think the principal social trend for the remainder of this century is one of mass disgruntlement, mass paranoia, anger and disaffection, with a feeling of disappointment with the American dream—an American dream fueled, of course, by mass communications fantasy, where all the television shows portray a hero or heroine who earns \$18,000 a year, and lives in a \$150,000 house which is always spanking clean with the most modern appliances.

One of the important consequences of this sense of failure will be increased disaffiliation and disaffection with the broader levels of commitment in the American scene such as traditional patriotism, and traditional values and organizations,

including traditional mass religions. This does not mean that we are heading into an anti-religious era. In fact, I feel we are heading into an era of very strong religious revival and new conservatism in a number of areas of life. Rather, I think we are heading into an era when the complex, intellectual ways of looking at the world will be increasingly ineffectual, and simpler, more emotional outlooks will predominate. This change in world view will lead to an increasing fragmentation and segmentation of American society.

In particular, one of the implications of the television-video revolution is the segmentation of the mass market. Television, for all its faults, has helped keep America a civil civilization, because when nearly all families watch a single show like "Roots," this is a common experience which helps define the American experience.

When Americans meet overseas, they tend to talk about the common television movies that they have seen. This establishes their credentials as belonging to the same civilization. But today already there are some fascinating consequences of the introduction of video disk, videotape and cable technology. You may be fascinated to learn that more than 50 percent of the videotapes sold in the home market this year are pornographic films.

This, I think, reflects the beginning of a major trend toward the segmentation of the market, so if you come back in ten years the video industry will look much more like today's record industry. There will be many small markets catering to specialized tastes, and consequently, a loss of a common denominator of American attitudes and values, no matter how low the common denominator may have been.

In conclusion, I want to say a word about work ethics. We are moving to an attempt in America to deal with the contrast between play and work. Traditionally American society has had two kinds of activities: play, which is fun, but non-remunerative, and work, which is unpleasant, but remunerative.

A larger and larger portion of younger Americans are demanding that work be more enjoyable. The pressure is causing less and less effective work in the job market and is leading to the restructuring of work. I think that in the future we will pay with reduced productivity for a more enjoyable work scene. However, an enjoyable work scene will be the only way we will be able to get workers to participate with any level of commitment in the work process. Let me stop there. I want to try to talk about it more afterwards.

DR. ALBERT MAYRHOFER: Because time is running short, I am going to take the liberty of excerpting from Mr. Kamm's presentation. His presentation is made from the frame of reference of one who has been an operating mechanical engineer for 38 years, particularly in the area of industrial automation.

The most conspicuous and chronic defect that Mr. Kamm observes in the American scene today is an inadequate supply of trained maintenance technicians. He observes that factory managers invariably are afraid to hire technicians because they have no way of evaluating them. As a result, factory managers are extremely reticent about adopting new technologies because they cannot be maintained.

Mr. Kamm observes that the effects of the shortage of trained people is severe. One of the consequences, of course, is that new equipment will fail in operation if it is adopted, since there is no one to service it and keep it going.

Even very simple technologies such as a compressed air operation are looked upon with disfavor because they require regular, although very elementary, attention, that is just not available. Another effect appears in the automobile industry. The big push here is to make machinery abuse-proof, meaning idiot-proof, and this costs substantial amounts of money.

Mr. Kamm holds that the basic problem is morale rather than a lack of cognitive or skilled learning. He presents a story about a workman, a maintenance worker, who smashed a die. Mr. Kamm points out that this man had a wife, children, car, TV set, washing machine, refrigerator, and he did not smash them with a big iron bar when they did not work properly. Mr. Kamm says that he personally, however, benefits more from this situation because he makes robots, and his own equipment is very carefully engineered to require only a most elementary understanding on the part of maintenance people, and his competitors' equipment is not.

One of the things Mr. Kamm counted as fouling up delivery of those machines to the field was that the technicians do not understand the instructions sent with them or they do not read them.

In all but the largest factories maintenance is done by a relatively small number of people who are expected to cover many subject areas, and they are not being prepared adequately in this. Mr. Kamm suggests that a system of ranking and examinations in licensing and rating would be most valuable in selecting employees and might very well be a substantial motivator of student technicians. Regarding grading and testing, Mr. Kamm points out that there is a great diversity in individual aptitude for dexterity and understanding of mechanisms and suggests that educators

do more aptitude testing and encourage those people who have these aptitudes to enter these fields.

There is a major question whether advanced technology calls for greater or fewer skills on the part of manufacturing workers. It is Mr. Kamm's personal observation that designers of machinery make a major effort to deskill the operation of their machines. The interior of such machines may be highly complex, but the challenge is only to the maintenance technician. A major objective of the internal complexity is to reduce the external operating skill.

Let us now consider the making of tools and machines used in quantity manufacturing. Here skills are required, unlike in mass production. A die typically is made in a quantity of one. A machine tool is typically made in quantities of ten. The need is as great as ever or perhaps greater for skilled mechanics in such categories as machinists, tool and die makers and precision assemblers. Although these people use modern machine tools and instruments, the skills required are as numerous as ever. Data indicates that the supply of such people is decreasing.

Regarding Mr. Kamm's present business, industrial robots will replace only unskilled workers performing simple, repetitive and monotonous tasks. For the most part they are used to load work pieces into fabricating machines and to unload them from fabricating machines. To some degree robots are used in automatic assembly, but here again robots can perform only the simplest kinds of assembly operations and therefore replace only unskilled or semiskilled labor. Robots are used to save money. They save money by replacing unskilled workers at a new reduction in cost. Such special cases as safety and the performance of obnoxious jobs are minor considerations

in the real worth of machinery purchasing. Mr. Kamm estimates that robots can replace approximately five percent of the blue collar workers in mass production today and perhaps another five percent in the foreseeable future.

As with all machinery, skilled workers are required to manufacture the robots. No unique skills are required other than those required for general machinery manufacture. In short, robots merely represent a continuation of the same industrial revolution, which has been progressing steadily for a very long time.

DR. MICHAEL HUDSON: I have been asked to talk about technology assessment in vocational education. Like everyone else on the panel, I do not have a degree in technology assessment. My own degree is in economics, and if there is any profession that is trained not to think about technology assessment, it is economics. Underlying all of the economic models in this country, including every economic model used by government, is the assumption that technology remains the same and that the social environment forming the setting for technology remains the same.

Economics was not always oblivious to technology and the social environment. Two hundred and three hundred years ago, at the inception of the industrial revolution, the central focus of mercantilist economics in every single country of Europe was the effects of technology on social values and the political policies necessary to provide countries with an advantage in technology. Ironically, the more rapidly technology has changed, the more governments and economists have assumed that it is a constant.

The few economists who begin to talk at all about technology have two separate approaches. The usual approach is to define technology in terms of output per

man hour. Each labor saving device produces more and more per man hour. Labor productivity is the only kind of productivity that is recognized under the government productivity indexes today. It suggests that workers themselves produce more and more, all by themselves each hour, and it is the argument for wage increases.

Understandably the labor unions and labor in general have a definite self-interest in popularizing this view, and they trace the evolution from manual labor to skilled labor as requiring more and more educational inputs. This emphasizes the need for laborers to finance more and more of their education and to accumulate what economists call human capital.

This concept has given birth to very many perceptions, and it has almost completely overshadowed the other concept of productivity which was shared by the classical economists, Ricardo and his predecessors. And that is the concept of productivity in terms of increasing capital per worker; the reason for increased production per man hour is because of the greater use of sophisticated capital goods. This is true all the way from the factories to the new automated office.

Today this concept of productivity is promoted mainly by the industrialists. They say we need more and more money, more and more profits, and more and more depreciation allowances, so that we can promote investment in these sophisticated capital goods.

Education represents a third constituency, neither labor nor business, that is not represented anywhere in government. Education's task is to somehow fit labor to the overall demands of a radically changing technological environment.

If your graduates cannot find jobs or if the only jobs they find are in the state and municipal governments, you get the blame for not turning out the people that the economy needs. However, you are not really told who the economy needs. You are sort of left in a kind of limbo.

I mean to say a few words about the history of vocational education because I think it is very important to provide a perspective on what you are doing now. The original work on vocational education in the United States began about a century ago, and it began in the State Department; specifically Jacob Shoenhoff and a number of other people perceived a totally different kind of economy emerging in the United States than was portrayed in the economic models taught in the universities.

The economic models in the universities then were just about as bad as they are today. They held that the way that laborers got work was to lower their wage demands. There was always some wage rate at which employment would be available. Shoenhoff, of the State Department, came up with a different theory, called the economy of high wages doctrine. It held that high wage labor would undersell low wage labor by being more productive. High wage labor would work with high productive capital, so that on a unit cost basis this labor would be even cheaper. This theory perceived what Henry Ford and other industrialists recognized: that they would rather hire high-skilled, highly-motivated labor to work because the greater productivity of highly-skilled labor more than offset its high wage rates.

As a result of this study, the United States government financed extensive reports on vocational education in the rest of the world in order to prevent the United States from being subject to international obsolescence. They saw correctly

a century ago that countries failing to modernize their work force would remain obsolete in the world and would fall further and further behind the rest of the world.

More importantly, they saw that what was at stake was not merely what economists called human capital, but an entirely new civilization, and it was a civilization based on motivation, the desire to improve one's lot, and they saw that their drive for money was a socially programmed incentive.

Why did people want money? Not just because they wanted money, but because they wanted social approval, resulting from the possession of money. Since that time, instead of America becoming a melting pot where more and more people want to succeed in money-making, America has turned into a multilayered society. Not everybody wants to get ahead financially.

Living in Manhattan, I see that most of its people really do not want to get ahead. They just want to collect the same welfare checks that all of their neighbors are collecting; thus the economy is turned into more or less a reservation in which industrial work is shrinking and shrinking and shrinking.

Now, there are two sorts of welfare recipients: the very rich and the very poor. They both live by clipping coupons and filling out forms and just collecting their checks. It is very difficult to put that into the traditional models.

Now, in this kind of situation how do you relate vocational education to technology assessment? Ann Martin mentioned a buggy whip in today's world

of the auto. I think that may be a little out of date, since I am sure none of you are training people to make buggy whips.

The problem is that those of you who are training auto mechanics may be training incompetent auto mechanics. Certainly from my experience in Manhattan there are very few competent auto mechanics. And even if you are putting out competent auto mechanics, most people who own autos do not believe that they are competent. As a result, there are numerous plans afloat to redesign autos with printed circuitry designs, so that if anything goes wrong with an automobile, a flashing little light on a really complex board will point out what part is malfunctioning. This would eliminate the need for auto mechanics.

It is very important for someone somewhere in the system to anticipate this potential scenario, and its effect on the need for the educational system to turn out auto mechanics. If no such assessment is made, education is going to turn out auto mechanics that are almost as obsolete as buggy-whip manufacturers.

Here is a little chart that shows the shift in the U.S. Labor force since World War II. Since World War II employment in the productive industries that represent your constituency—agriculture, manufacturing, public utilities, power generation and transportation—has held fairly steady at 30 million people.

Nearly all of the 30 million growth in the labor force since World War II has been in the service sector, and this is the sector that is supported by your productively employed corps. Of this growth about one-third, ten million persons, represents employment by state and municipal government. These are people who cannot find jobs in private industry.

The result of this drastic increase in public employment is the huge mushrooming of state and local debt. The well has now run dry. With New York's bankruptcy, states and municipalities can no longer borrow to keep hiring people that are not trained for employment in the private sector. Yet it seems that the private sector may be unable to employ all these job seekers.

Although the productive labor force has remained steady at 30 million persons, the composition and nature of this labor force has undergone a vast structural change. There has been a sharply increasing amount of capital per worker. With higher capital per worker, increasing skill levels are required along with changes in social values toward work and motivation.

If the worker is working with highly productive, expensive capital, it is necessary that he not break it. And one of the first concerns of employers, obviously, is to get the kind of worker who is going to take care of the capital and not break anything.

Now, that brings up the question as to what labor does to influence its long-term employment. Economists hold that labor should simply lower its wage demands. There is, however, very little room for labor to lower its salary demands. Labor has certain break even costs: the costs of feeding itself, the costs of clothing, paying rent. There is hardly any discretionary income left to American blue collar labor today. There is no way that the average worker can lower his salary demands without becoming very demoralized, having to eat less, and having to move into a bad neighborhood. The flexibility is gone from the American economy as labor has lost its downward wage mobility.

Now how much can education do to serve the long-term problem? Not all that much. It can try to provide specific work skills that are needed. It can try to imbue students with appropriate work attitudes and cultural mores, the instincts for workmanship, and it can try to give a general appreciation of what are the prospects for employment.

If economists themselves do not discuss the changing technological environment, if government does not, how can you folks be expected at the local level, all by yourselves, to figure out what jobs are necessary? I do not think there is any conceivable way in which you can be expected to do that. But you can be blamed for it, and you probably will be blamed.

Your only recourse is to have the government take some responsibility for informing you as to where, to the government's best knowledge, the demand for labor is. Government must not merely correlate existing microdata and determine past trends, but must draw up scenarios for possible, plausible future trends and what they will require of the vocational education system.

And once again, how do you even go about analyzing these trends? Any trends are going to be projected in a kind of statistical format. But the statistics always have to be questioned because any set of statistics is created within a set of conceptual categories. And the categories at the head of each statistical column represent a theory. And everybody who develops a theory usually develops it on contract for somebody, and therefore this theory reflects somebody's self-interest.

Now, at the beginning of the talk, I mentioned the two basic self-interest group theories today. There is the Labor Department talking about labor trends and labor productivity, and there are the specific lobbying groups and industry associations focusing on capital productivity. I do not believe that educators can sit passively and uncritically accept either of these theories. And the fact is that there is only one trend even provided by government, and that is not done by the Office of Education, that is done by the Labor Department for labor trends.

I think that you need to develop your own educational models, and that requires the development of your own theoretical context in which to elaborate these models. I think that these models, by their very nature, would have to be iconoclastic and skeptical of the existing models. You would have to take an outsider's view and determine for yourself what are the most relevant categories, as they affect education, in terms of the skills that have to be trained, the social context and the motivational systems.

And unless you get sufficient government support you will probably be the ones left holding the bag if the American economy turns out to be increasingly obsolete in the industrial sphere, overtaken by other countries that are paying more and more attention to the educational inputs and social inputs required by the current technological revolution.

PART IV - REACTOR'S COMMENTS

MS. DAINS. My name is June Dains. I am here today as a member of the American Society of Training Directors. Professionally, I am personnel director of the Nistrom Division of the Carnation Company.

I am very happy to be here today, to share in this discussion on technological training. It seems to me it is quite evident this country has far greater opportunities for the individual and for business than it is using. As I listen to each speaker, again, it supports what has been my thinking for a long time.

We just have to find the answers. On the one hand, we have individuals who are very desirous of furthering their own self-development, of being in a position to live a very meaningful life, to contribute to society and to do a very meaningful job. On the other hand, it seems that we have school facilities and educators who are offering the opportunity to learn.

What seems to be the problem? We also have in business many job openings that we cannot find the skilled individuals to fill. That was mentioned a number of times earlier in the discussions. I think Dr. Martin mentioned earlier that she saw a great need for better feedback of the training that is now being done. I think that is very true, that somewhere, industry has to provide greater feedback to the data clearinghouse or other medium which is going to be utilized in planning the curricula for the training and technological needs.

I am sure that we have been remiss in this for a long time. We get entirely too busy in trying to meet our own current needs rather than planning for the future.

In this three minutes that I am allotted, I do not have time to go into the question with any depth, but I think we have the ability to solve our problems. What we have to do is get out act together, work together, make sure that the needs are understood. And then I think we will find an answer for the needs.

MR. KOOPMAN: My name is George Koopman. I am chairman and former president of Instructional Systems Group in Huntington Beach, California, which develops validated self-instructional programs. We produce about 150 to 200 a year. Our clients include everybody—Sambo's Restaurants, the U.S. Defense Department and the California Community Colleges.

I am also the managing director of an agency in Los Angeles, which represents several dozen of the country's thinkers, futurists in a number of different areas. And I am also an independent producer in the media business and have a television series and a motion picture under production at a moment.

I feel like I am somewhat of an alien here, although I hope not to alienate anyone. I am the only one on this platform, I believe, who operates from a base west of the Mississippi. And so I am here representing the western half of the United States. I feel in some ways like I am at a technology assessment session being held in 1492, in the appropriate settings of the court of Queen Isabella, in which as a small footnote to the appendix on condiments, it is noted that the projections with regard to the spice market may be slightly off, due to a small expedition to the Indies by someone named Columbus.

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My three-minute contribution here this afternoon will be to try to give you a couple of ideas to roll around in your heads which I think are going to very radically affect the way in which all of us do business in the next decade.

First of all, several people including Bert Cowlan have mentioned the proliferation of satellites. It might be of interest for you to note that the same men who are making the decisions to invest in this technology (for example, Aetna Life & Casualty has just committed to invest \$312 million in satellite business systems) are betting that within the decade, low-earth orbit solar satellites will be under construction. The answer to the question as to what will happen to technologically replaced individuals is that, just as in 1492, a new frontier is opening up.

The men who are making the \$100 million commitments today are saying that we will be pumping solar power, collected by satellite solar power stations, down to earth by 1992, the 500th anniversary of Columbus' voyage. The careers you had better start training people for are not necessarily on this earth.

Another idea which you should mull over is, as Herb Gerjuoy mentioned, the increase in life expectancy. However, it is increasing much more radically than most of us realize. I expect to live to be at least 150, probably 400. It is considered to be a somewhat conservative scientific prediction today to say that within 10 to 20 years, we will be able to double the human life span.

It is a simple matter of the fact that the aging problem for every single one of us is built into our cells in the DNA. Right now we are learning how to literally change that program. For example, Dr. Paul Segal at the University

of California at Berkeley is currently keeping rats alive--not only alive, but in the prime of life--for two to three times the normal total lifespan of a rat, and he is doing that by simply withholding one amino acid from their diet.

And the third idea which I'll give you to think about is the idea of intelligence increase. We have heard some pessimistic predictions about the detrimental effects of computers and mass communications. I would submit to you that although this may be a short-term effect of the electronics revolution, the basic long-term effects will be to increase the power of the individual. Modern technology will help people to get smarter. The Defense Department, which is currently leading the country in educational innovation, is teaching uneducated individuals to operate complex multi-million dollar systems.

I hope to leave you with a message of hope, in contrast to the many pessimistic projections put forth by the other speakers. I would like to tell you that I am an optimist, and that it appears from my perspective on the West Coast that things are getting better and not worse, that we do have a new frontier, that we do have new opportunities, and that in a phrase, doomsday has been cancelled. Thank you.

MR. SMITH: I am Clinton Smith, of the Office of Personnel Management, formerly the Civil Service Commission. I have been asked to give you a brief outline on what the public service, as a major employer, has concluded regarding the issue of employment and technological needs for the present and the future. My comments particularly will respond to a number of remarks by Dr. Gerjuoy, Dr. Hudson, and Mr. Kamm, which I thought were particularly pertinent in this connection.

First of all, the U. S. Civil Service system, including federal, state and local levels, is probably the biggest employer of the nation. And we have concluded over the last few years (These conclusions are contained in a large part in a report on management of human resources prepared by the Interagency Advisory Group, with which I have been affiliated for the last nine years) that approximately 70 percent or more of the budget, in any federal agency, goes into human resources: payroll costs, insurance, retirement, et cetera. When we consider that this leaves 30 percent or less for everything else, there is no question that we must focus on better management of people.

A part of our solution has been to focus in on the overall management in organizations. We start with the premise—or, the fact, really, that the Office of Management and Budget, since about 1974, has required specific action plans, management plans, by each federal agency. We tie into those management plans the budget projections, of course. More recently, and this is where we feel we have been taking some significant steps, we have been motivating agencies to take positive action to forecast their own particular needs. That is, if we can outline management plans and budget plans, there is no question that we can do a better job in forecasting the skills and knowledge and abilities needed to carry out those management goals.

We have found, particularly by looking at the regulations on the books with regard to human resource management, that there is no question we can focus accountability on managers to do a better job of affirmative action in this area. Overall, I would sum up in my brief comments by saying that when we consider the amount of money that goes into public service in this country, approximately three-quarters of the total Gross National Product, we have a good starting point

for productivity emphasis and better management overall. We look forward to cooperating with this organization and others and the education area in this whole effort to do a better job of forecasting our needs. Thank you.

MR. NELSON: I am Ray Nelson with the Milwaukee Railroad. I think it is very interesting that with all of this talk of satellites and extremely high technology industries, Dr. Martin would have a railroad man on her panel. I do not suppose railroads are recognized as using high technology, but we do have our share.

My title is manager of technical training, from which you might infer that I manage some technical training. My stock in trade, which I consider my personal craft is that of an instructional designer. While listening to the presentations, my mood has alternated between elation and depression, as I hear some predictions of progress and others of doom. Instead of reacting to these presentations, I am going to discuss developments—some very positive developments—that have been happening in our industry, primarily due to education and work planning initiatives.

Being an instructional designer, you can bet that I am going to make a case for instructional design and the processes that we go through. A meeting that took place in St. Louis about a year ago, sponsored by the FRA and attended by railroads and labor dealt primarily with sources of government funding for railroad training. Apparently, this meeting encouraged a great deal of interest on the part of community colleges and vocational and technical colleges in railroad training needs. The initiative, of course, is determining those needs.

We are a little unclear right now as to where we begin. But I know there is interest on the part of the junior colleges and community colleges in the needs

of the railroad industry. We are planning to conduct some job analyses in order to identify the basic jobs, the critical skills that we have in our industry, and the knowledge and skills necessary to perform those jobs. In the future information like this could be made available to vocational and training people, so that they could attune their curriculums to meet the stated needs of industry.

So although it is difficult for me to respond to the futuristic presentation here, I did want to point out some positive steps taken in our industry toward establishing these linkages with education. Our industry needs trained workers. There are no good skilled mechanics walking the street looking for a job, as Mr. Kamm has pointed out. And we have found that we are coming up to a 30-year retirement cycle right now and many of the retirees are in critical occupations.

MR. PRATT: I am George Pratt, Special Assistant for Education, Office of the Secretary of Commerce. The reason we have a special assistant for education is because institutional education is the largest enterprise that we have in the country, involving 30 percent of our citizens. This does not include business and industry education, and I count government in there.

Institutional education has an operating budget that is an estimated \$170 billion, and that does not count another \$100 billion that industry and government invest in it. We cannot afford to ignore this vast investment in any planning process.

I heard some discussion about whether we should adopt the economic model that says it is the worker that is key to productivity or it is capital that is paramount. We found out when we got a second-generation computer in 1955, that traditional

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economic models would explain but 15 percent or less of the measurable growth. And to make a long story short, they decided that maybe investment in human capital, which is what you are about, is a function of productivity. I want to remind you that there has been a Presidential review memorandum that was sent to President Carter from the Department of Commerce after involving the leadership in technology consumers and organized labor, on what government can do, what we all can do to help with innovation, and then how we can market that.

Secondly, the Department of Commerce, Patents and Trademarks Office has a new publication out on technology assessment. We heard a lot about computers here today. We did not hear very much about energy, but there is a lot going on there.

George Koopman mentioned the matter of the rat experiments at Berkeley. And he referred to the deoxyribonucleic acid, DNA. DNA was discovered in 1954, but it is just been this year that scientists found out that by replacing a gene in DNA, they could actually manufacture insulin, instead of getting it from laboratory animals.

There is potential for this biotechnical area to surpass the electronics industry. We know, for instance, that soybeans have the unique property of being able to reproduce their own nutrients in the soil. But with DNA, maybe we can do that with corn and wheat and all sorts of plants.

The number of people who have been employed in heavy industry in this country has not changed in 25 years. What has changed has not been just in government.

At the turn of the century, one out of eight workers were in the knowledge field. It took from 1900 to 1955 for that to become one out of four. In 1973, it went beyond one out of two. Fifty-three percent of the people that work are knowledge workers, which gets back to the comment of one of our panel members, regarding the importance of basics. When you get down to computer assistance, a \$20 dollar hand held computer has more computing power in it now, with semi-conductors, than the biggest computer we had in the middle 1950's.

The applications of that kind of technology are just out of sight. And I would conclude with the fact that that kind of technology presents the capacity for you as innovators to progress from providing education for all to education for each. And it is up to us as professionals to do that.

As far as worker alienation is concerned, technology enables us to go into something called flexible mass production. And I would invite you to look at Peter Drucker's 1973 book entitled, Management: Tasks and Responsibilities, and find out what flexible mass production does in terms of productivity, and what it means to you as educators.

PART V - CONCLUDING REMARKS

Ms. Arns: My name is Kathleen Arns and I am assistant vice president for vocational curricula at Oakton Community College, Morton Grove, Illinois, which is one of the host schools at the AAJC convention. In addition, I am the incoming president of the Council on Occupational Education. My role today is to summarize what has gone on during the past two hours. And I must confess that it is a mind-boggling task.

I am sitting here, and the thing that keeps going through my mind is, now I know why God quit and gave himself a rest on the seventh day. He knew what was going to come. However, to try to summarize what each of our speakers has said, let me go back first to Mr. Conant, who gave us a general overview of the work force. Mr. Conant said, among other things, that the major multinationals do not expect an increase in employment, despite an increase in output, and that this reflects a change in process technology, and the end of the industrial age.

Mr. Cowlan then followed with remarks that led me believe that what we are really dealing with is the global village where inventions that take seven to ten years to implement in industry take 40 years to implement in education. He talked a great deal about telecommunications technology, and the effect that it would have on the society.

Dr. Gerjuoy talked about the characteristics of the work force in the year 2000: the decrease in the birth rate, the increase in longevity, the job trends and social trends.

Mr. Kamm's remarks delivered by Dr. Mayrhoef, dealt with what he perceived as the reticence of industry to adapt to new technology, because of maintenance problems. He considered morale to be a big problem and also emphasized the need for aptitude testing. He reassured us that robots are only going to be used for quantity manufacturing, and would take the place of unskilled workers.

Dr. Michael Hudson summarized an overview of how technology assessment information can be used in education to solve short and long-term training problems. He emphasized the failure of economic theory to take into account the impact of technological change. Hudson did make a very startling statement when he said that flexibility has gone from the American economy.

Our first reactor was June Dains from the Carnegie Corporation, representing the American Society of Training Directors. June feels that the United States has greater opportunities than we are using, that individuals want increased education, and that educational institutions have the capacity to meet this need. She believes that a team effort is needed to resolve the problems that exist today.

George Koopman from the West Coast emphasized the new opportunities stemming from technological change: satellite power stations, increased intelligence and life expectancies, etc.

Clinton Smith spoke of the role of public service as a major employer, and concluded that we need better management of human resources, focus on overall management of organizations, and that budget planning needs to be tied to management planning to forecast what our needs will be in the future.

Ray Nelson from the Milwaukee railroad, representing the American Society of Training Directors, mentioned that many initiatives have been undertaken in the railroad industry. He pointed out that the railroad industry is accumulating information on the type of skills needed for its jobs which could be shared with education.

George Pratt pointed out the great size of the educational industry—over \$170 billion is spent on institutional education. He contended that an investment in human capital is an investment in productivity. He also suggested that the potential for biotechnical advances may surpass electronics.

I would like to remind you of the objective of this conference. It was and hopefully we have succeeded, in creating an awareness among junior and community college educators of the fact that there are a great many changes going on today. This is the kickoff initiative. What we would like to see happen is the development of regional meetings springing off from this initial conference.

The proceedings of this conference, as Dr. Martin has said, will be distributed to all who are in attendance. However, the strategy over the next 18 months is

to hold regional meetings so that educators can talk about the kinds of activities that we need to undertake to do educational assessment.

If any of you in the audience today feel that there is a potential for hosting a regional meeting, either on your campus or in your area, I would urge you to contact Dr. Martin. And at this point, I would like to thank you all and turn this meeting over to Dr. Ann Martin.

DR. MARTIN: Thank you. And thank you all for sitting through this so patiently. Just two words. The first is, if you have not signed up, we do want to send you the proceedings.

The second is, we would like to have feedback from you as to interest in regional meetings; and third, if we have your name and address, the Council on Occupational Education will send you a little questionnaire, on which you can comment on this meeting.

I would like to maybe just have the panel field one or two questions, that is, unless management gets very upset and tosses us out of here. And so we will take maybe two questions. But I have had urgent requests from the pessimists over here?

MR. COWLAN: I do not know if I am speaking for all of the so-called pessimists, but I do want to raise one question.

In a country where seven or so nuclear reactors are about to be closed down for engineering design defects, where three and a half million automobiles have been recalled in the last two years for faulty engineering, sticking brakes or failing

brakes or sticking accelerators, and where the Long Island Railroad and most commuter railroads are sad, sick jokes, I wonder whether any optimist really does believe that the body politic in this country is going to stand still for being zapped by solar energy from outer space. And I would suggest only that we have been talking about social politics and social dynamics on this side of the table, not about technology.

MR. COWLAN: I'd like to say one thing about our being pessimists. The more goes wrong with technology, the better our job prospects are. We are very optimistic.

You should be the pessimists. If anything goes wrong with technology, you are going to be left holding the bag and you had better have some way of understanding what technological changes are, to avoid holding the bag, or you will really be pessimistic.

MR. CONANT: I would like to comment. Although I am not a scientist, my father was a fairly eminent scientist, my grandfather won a Nobel Prize, and I grew up in a household with the likes of Fermi and Oppenheimer, George Cheskechowsky. These people would be most upset to hear some of the speakers from the other side of the table talk about quick fixes through science and technology. There are no miracles in science and technology, and people who sort of create a secular religious opiate, a secular religion that science and technology will somehow produce miracles are as phony as those old DuPont ads about miracles through chemistry.

DR. MARTIN: I know the panelists will be available afterwards. Could we take two questions? Is there anyone that has a question for one of the panelists?

If not, I will turn this back to Andy Korim.

MR. KAMM: As the convenor, I am the adjournor. I would like to say this: This has been a very good session, and we are pleased to be able to draw so many this afternoon.

If you wish to carry on personal discussions with any of the panelist, reactors, you can do it in Room 706. Thank you for coming this afternoon.

PART VI - LIST OF CONFERENCE PARTICIPANTS

(PRESENTORS AND REACTORS)

APPENDIX A

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